UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northwest Region
7600 Sand Point Way N.E., Bldg. 1
BIN C15700
Seattle, WA 98115-0070

August 19, 2002

Thomas F. Mueller
Chief, Regulatory Branch
Department of the Army
Seattle District, Corps of Engineers
Post Office Box 3755
Seattle, Washington 98124-3755

Re: Endangered Species Act Section 7 Formal Consultation and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for Edman Holdings LLC. Wharf and Intertidal Habitat Creation and Enhancement, Commencement Bay, Tacoma, Washington (NMFS No. WHB-01-132, COE No. 1997-2-01831)

Dear Mr. Mueller:

In accordance with Section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 *et seq*.) and the Magnuson Stevens Fishery Conservation and Management Act (MSA), as amended by the Sustainable Fisheries Act of 1996, the attached document transmits the National Marine Fisheries Service's (National Oceanic and Atmospheric Administration [NOAA Fisheries]) Biological Opinion (Opinion) and MSA consultation on the issuance of a permit for construction of the Edman Holdings LLC. wharf and intertidal habitat creation and enhancement, Commencement Bay, Tacoma, Washington. The Army Corps of Engineers (COE) determined that the proposed action may affect, and is likely to adversely affect the Puget Sound chinook (*Oncorhynchus tshawytscha*) Evolutionarily Significant Units (ESUs).

This Opinion reflects the results of a formal ESA consultation and contains an analysis of effects covering the Puget Sound chinook. The Opinion is based on information provided in the Biological Evaluation (BE) sent to NOAA Fisheries by the COE, and additional information transmitted via telephone conversations, fax, and e-mail. A complete administrative record of this consultation is on file at the Washington Habitat Branch Office.

The NOAA Fisheries concludes that implementation of the proposed project is not likely to jeopardize the continued existence of Puget Sound chinook. In your review, please note that the incidental take statement, which includes a Reasonable and Prudent Measure and Term and Condition, was designed to minimize take.

The MSA consultation concluded that the proposed project may adversely impact designated Essential Fish Habitat (EFH) for 17 species of groundfish, four coastal pelagic species, and three species of Pacific salmon. The Reasonable and Prudent Measure of the ESA consultation, and Term and Condition identified therein, would address the negative effects resulting from the proposed COE actions. Therefore, NOAA Fisheries recommends that they be adopted as EFH conservation measures.

If you have any questions, please contact Rachel Friedman of the Washington Habitat Branch at (360) 753-4063.

Sincerely,

for Michael R Crouse

D. Robert Lohn
Regional Administrator

Enclosure

Endangered Species Act - Section 7 Consultation

Biological Opinion

And

Magnuson-Stevens Fishery Conservation and Management Act

Essential Fish Habitat Consultation

Edman Holdings LLC. Wharf and Intertidal Habitat Creation and Enhancement
Commencement Bay, Tacoma, Washington
WSB-01-132

Action Agency:	U. S. Army Corps of Engineers
Consultation Conducted by:	National Marine Fisheries Service Northwest Region

Approved Michael R Crouse
F.6 D. Robert Lohn
Regional Administrator

Date Issued: 08/19/2002

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1.0 INTRODUCTION

1.1 Background/Consultation History

The U.S. Army Corps of Engineers (COE) proposes to issue a Clean Water Act Section 404 permit to Edman Holdings, LLC, a wood products facility, to construct a 289-linear foot (15,935 square feet) wharf and install dolphins and fender piling in the Hylebos Waterway, Tacoma, Commencement Bay, Washington. In addition, the project will relocate an existing stand of pickleweed on site, will remove concrete debris and derelict wooden pilings, and create an area of intertidal habitat. The purpose of the wharf proposal is to facilitate the existing processing of wood chips and logs. Presently, the facility uses land transportation to receive raw material and export wood chips. The proposed project will provide access for the waterborne transport of logs and processed wood chips, thus supporting the enhancement of the facilities' production capacity.

The COE requested section 7 consultation under the Endangered Species Act (ESA) on April 9, 2001 with the submittal of a biological evaluation (BE) and a call of "likely to adversely affect listed species." At the same time, the COE requested consultation under the Magnuson-Stevens Fishery Conservation and Management Act (MSA) with a determination that the action may adversely affect designated Essential Fish Habitat (EFH). On June 25, 2001, the National Marine Fisheries Service (National Oceanic and Atmospheric Administration [NOAA Fisheries]) replied with a request for additional information. After appropriate information was gathered, formal consultation was initiated on April 24, 2002.

The purpose of this document is to determine whether the proposed action is likely to jeopardize the continued existence of the Puget Sound chinook salmon (*Oncorhynchus tshawytscha*) under ESA and adversely affect designated EFH for 17 species of groundfish, four coastal pelagic species, and three species of Pacific salmon under MSA.

The NOAA Fisheries reviewed the following information and engaged in the following steps to reach its determination and prepare this document:

- March 3, 2001 submittal by Edman Holdings of the first BE addendum;
- June 28, 2001 meeting with the Edman Holding representatives and U.S. Fish and Wildlife staff (USFWS);
- August 20, 2001 submittal by Edman Holdings of a subsequent BE addendum;
- October 24, 2001 request from NOAA Fisheries for additional information and additional minimization measures;
- December 27, 2001 submittal by Edman Holdings representatives responding to October 24, 2001 request for additional information and additional minimization measures;
- April 12, 2002 submittal by Edman Holdings of a revised BE incorporating additional minimization measures. Received by NOAA Fisheries on April 24, 2002.

In addition, other information was informally transferred via email and during meetings between the NOAA Fisheries, USFWS , the COE and the applicant during the preparation of this document.

1.2 Description of the Proposed Action

It is important to note that the design of the proposed structure is conceptual, as no preliminary design (30% design) has been completed for the wharf. The applicant has emphasized that responses to some of NOAA Fisheries' questions about the project's design will not be known until the final design phase. They have indicated that the design will be based on the current industry standard, which has been implemented at the Port of Tacoma and other locations.

Consequently, this document is based on a conceptual design. This approach will require NOAA Fisheries to work closely with the COE, following completion of the document, on refining the preliminary design and other elements of the project. The following description is NOAA Fisheries' understanding of the project's design features.

A 289-linear feet (15,935 square feet) concrete-surface wharf on concrete piling will be constructed along the pier-head line of the Hylebos Waterway. The pier will extend from the shoreline, at elevations ranging between + 12.1 feet mean lower low water (MLLW) to + 15.1 feet MLLW, to the pier-head line in the waterway, at elevations ranging between minus (-) three feet. MLLW to -12 feet. MLLW. The wharf will be constructed of concrete (and possibly steel) piling sized 24 inch diameter or less, with spacing between 12 and 15 feet. The wharf will also include pile bents spaced approximately 25 feet. apart. In addition to the wharf, the project will include five concrete breasting and two mooring dolphins and a concrete catwalk. The orientation of the wharf within the waterway will be east-west. The shoreline under the wharf will be stabilized with a steel sheet pile wall installed with an impact hammer. The sheet pile wall will have a 5-foot setback from Ordinary High Water Mark (OHWM). The wall will be driven 20 feet. into the ground and will be supported by rip rap. Construction will occur in late summer through late winter.

The wharf has been designed to allow light penetration to the underlying mud flat. The eastern side of the wharf will attach to the uplands with a 20 foot wide pier which will have five-foot grating on either side. This pier will support a covered chip conveyor system. The western portion of the wharf will attach to the uplands with a 140 foot wide pier. This section will support the machinery used to load/unload raw logs. A 4,640 square foot wharf window will be provided between the eastern and western piers.

Project minimization will include the 4,640 square foot wharf window, removal of derelict pilings and concrete debris, relocation of approximately 745 square feet of existing pickleweed (*Salicornia virginica*) from beneath the proposed wharf, and the creation of a new 15,392 square foot intertidal habitat on existing upland fill. The concrete debris and piling removal will occur during the late summer/early fall. The new intertidal habitat will be created from approximately 0 feet. MLLW to + 11 feet. MLLW. The project will include placement of complex large wood and planting of intertidal vegetation. The intertidal habitat creation project will take approximately five months to construct and will be constructed during the summer and early fall. This intertidal habitat creation is intended to supplement upper intertidal habitat which has been documented as limited in the action area as well as offset the adverse effects of the proposed wharf (Simenstad 2000). The existing pickleweed will be salvaged by hand during the early fall, and will be replanted onto an amended mudflat area, of similar elevation, that will be approximately 1,490 square feet in area. The doubling of area is intended to offset the effects of replanting and of the loss of productivity under the proposed wharf.

Summary of Conservation Measures Proposed by the Action Agency

The following conservation measures will avoid, minimize or reduce certain effects of construction of the proposed structure:

1. No in-water work below OHWM will be completed between February 15 and August 15 of any year;

2. Using larger diameter piles to reduce the number of piles needed to support the pier;

3. Preventing all construction materials from entering the Hylebos Waterway during construction;

4. Removing all manmade debris at the site waterward of OHWM to 0.0 feet. MLLW. In addition, a portion of an existing asphalt/concrete ramp within the upper intertidal area, not covered with eight inches of sediment, will be removed. All debris will be disposed of at an approved landfill;

5. Minimizing the width of the wharf by constructing it in a manner such that the maximum wharf to shoreline distance is no greater than 110 feet.;

6. Incorporating grating on the northern portion of the wharf. That portion of the wharf is 20 feet. wide, of which the outer five feet. on each side of the ramp will be grated;

7. Using steel or concrete for all in-water construction material;

8. Locating the sheet pile wall landward of OHWM;

9. Placing large woody debris (LWD) and large rock (the interstices to be filled with 0.25 -1.0 inch crushed, screened gravels) separately and/or incorporated into the erosion control measures. No information was provided on the number or location of the LWD nor on the design that will be used for erosion control;

10. Stockpiling construction materials on the upland area or in barges. Prohibiting the use of equipment in the intertidal zone, except when used from barges;

11. Relocating 745 square feet of *Salicornia sp.* (or pickleweed) that will be shaded by the proposed pier and re-establishing on an amended 1,490 square foot bed. The size of the existing pickleweed patch will be surveyed prior to onsite actions and the re-establishment area will be double in size;

12. Creating 15,392 square feet of high intertidal habitat off-site (from + 11 feet. to + six feet. MLLW) by excavating uplands on a peninsula owned by the Puyallup Tribe of Indians within the Hylebos Waterway. Creation of some fraction of the 15,392 square foot area (yet defined) as intertidal beach between 0.0 feet. and + six feet. MLLW. Enhancing this created site by placing LWD (four rootwads and four logs). No information was provided on the design or location of the LWD or the amount of intertidal area;

13. Removing unused piles (via breaking off just below the surface) and concrete debris from the intertidal habitat in the Hylebos Waterway, between the project site and the new off-site intertidal area;

14. Incorporating a "wharf window," into the area between the two pier approaches;

15. Prior to the installation of the new pilings, a six inch layer of clean sand will be placed in the intertidal area within a 35 foot radius of two locations which have been determined to have sediment contamination;

16. Artificial lighting will be installed under the proposed new wharf and would operate from one-half hour before dawn to dusk each day during the months of March through June to mimic the ambient light. Detailed design, operation and/or maintenance plans have not been provided;

17. An operational manual for barge and tug operators will be developed and implemented;

18. The final design for the proposed wharf and adjacent upland work area will utilize directional lighting to minimize the ambient night-time light levels;

19. Monitoring of physical and biological factors will be conducted during numerous stages of the project:

    a. Photographic documentation on-site and off-site will occur prior to the start of the proposed actions;

    b. Construction activities will be monitored by the project biologist and "record-drawings" will be developed following the completion of construction and habitat creation and enhancement;

    c. Success of the "wharf window" and artificial lighting program will be evaluated over five years. This evaluation will include a beach seine sampling program three times a year at two sites (within the “wharf window” and directly east of the facility within the “preserved” on-site area) during mid-April, mid-May, and mid-June. In addition, the artificial lighting will be evaluated using fish traps three times a year at three sites (corresponding with the beach seine locations, and under the proposed wharf);

d. Success of the transplanting of the pickleweed patch will be evaluated annually near the end of the growing season in September over a five year period. In addition, a report will be generated after completion of the planting which will assist with the future monitoring and final project assessment;

e. A five year monitoring plan evaluating the efficiency of the chip conveyor system and wood waste management practices will be developed and implemented. No plan has been provided; and,

f. Annual reports will be prepared and delivered to the COE and NOAA Fisheries.

20. During the construction of the habitat creation project several measures will be used to minimize construction impacts:

    a. Analyze for contaminants in the underlying soils. Any contaminated soil or sawdust material to be removed. Where necessary, backfill with appropriately sized, clean material;

    b. Excavation within the intertidal zone only when tidal elevations are below + six feet. MLLW;

    c. Surrounding the construction site with a floating boom to contain any material that may float away from the construction site; and

    d. Installation of silt fencing and hay bales to control erosion from the upland edges of the excavation, stockpiling and staging areas, and haul roads.

1.3 Description of the Action Area

The action area is defined as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 C.F.R. 402.02).

The action area for the proposed project includes that portion of the Hylebos Waterway influenced by marine waters, and Commencement Bay proper.

2.0 ENDANGERED SPECIES ACT

2.1 Biological Opinion

2.1.1 Status of the Species

The listing status, and biological information for the indicated species are described in Table 1.

Table 1.

Species (Biological Reference)	Listing Status Reference
Chinook Salmon from Washington, Idaho, Oregon and California, (Meyers, *et al.* 1998).	The Puget Sound ESU is listed as Threatened under the ESA by the NMFS, (64 Fed. Reg. 14308, March 1999).

Table 1. References to Federal Register Notices containing additional information concerning listing status and biological information for listed and proposed species considered in this biological opinion.

The species status review identified the high level of hatchery production which masks severe population depression in the evolutionarily significant unit (ESU), as well as severe degradation of spawning and rearing habitats, and restriction or elimination of migratory access as causes for the range-wide decline in Puget Sound chinook salmon stocks (NMFS 1998a, and 1998b). The understanding of the risk to naturally reproducing fish from a continuous infusion of artificially produced fish is unclear without extensive studies of the relative production and interactions between hatchery and natural fish. Without such information, the presence of hatchery fish in natural populations leads to substantial uncertainty in evaluating the status of the natural population (NMFS 1998a).

Puget Sound chinook salmon of this listed ESU that are likely to be adversely affected by the proposed action are present in Commencement Bay and within the action area (Water Resource Inventory Areas [WRIA] 10 & 12). Chinook use Commencement Bay as a rearing and migration corridor, and spawn in the Puyallup River (SASSI 1992). Beach seine and townet samples have been collected over the years (PIE 1999; Duker *et al* 1989; Simenstad *et al* 1985), providing valuable information on the presence and timing of juvenile salmonids. Many of these sampling activities were conducted in the Milwaukee waterway and across the mouth of the Sitcum waterway, in the Blair and Hylebos waterways. The occurrence of juvenile chinook corresponded with the latest date of sampling (mid September). The issue of estuarine residency is uncertain.

Three stocks of chinook salmon rear and migrate within the Puyallup River delta and Commencement Bay. These stocks include the White (Puyallup) River spring, White River summer/fall, and Puyallup River fall stocks (SASSI 1992). There are differences among these stocks both in run and spawning timing and location of spawning grounds (SASSI 1992). Chinook salmon of the Puyallup River basin exhibit primarily ocean-type life history strategies. Smolts migrate to the ocean during their first year, mature at ages 3 and 4, and have coastal-oriented ocean migration patterns (Myers *et al.*, 1998).

Duker *et al* (1989) described the likely use of the Puyallup delta and Commencement Bay estuary by juvenile chinook in its current, highly modified state. Commencement Bay has been documented as a rearing and migration corridor (SASSI 1992). Smaller, more nearshore-dependent ocean-type chinook begin to enter the estuary as early as February, with migration into the estuary continuing until late summer (PIE 1999). The later entrance of wild chinook is masked by the arrival of hatchery-origin chinook in mid-May (Duker *et al* 1989). The smaller juvenile chinook face the greatest challenges in their critical transition from freshwater to saltwater because of the significant modifications to the Puyallup River and estuarine shoreline (Simenstad 2000).

As described in numerous published papers on the subject of juvenile salmon in tidal floodplains and estuaries (Healey 1982, 1991; Macdonald *et al* 1987, 1988; Myers *et al* 1998; Simenstad *et al* 1982; Tschaplinski 1982, 1987), the early life-history stage between freshwater and the ocean can be very important in determining adult return rate. Juvenile salmon use estuaries for physiological adaption, foraging, and refuge. As described by Simenstad (2000), some aspects of the early life history of juveniles in estuaries are obligatory, such as physiological requirement to adapt from freshwater to saltwater. Healey (1982) described the use of the shoreline by young chinook as one of extreme dependence for feeding, rearing and refuge.

Other attributes of estuaries promote behaviors that enhance survival, such as minimizing salmonid mortality from predation by their seeking estuarine shallow-water vegetation (e.g., eelgrass meadows), and turbid habitats. Juvenile salmonid growth is enhanced in estuaries by the availability of high densities of potential food organisms available along the shallow nearshore habitats (Meyer 1979; Miller 1993; Miller and Simenstad 1997; Simenstad 1993; Simenstad *et al* 1982; Myers and Horton 1982; Pearce *et al* 1982; Shepard 1981; Thom 1987). Generalized habitat requirements of juvenile chinook in estuaries include shallow-water, typically low gradient habitats with fine, unconsolidated substrates and aquatic, emergent vegetation, areas of low current and wave energy, and concentrations of small epibenthic invertebrates (Simenstad *et al* 1985).

Habitat alterations and subsequent availability, on the other hand, are clearly understood to impose an upper limit on the production of naturally spawning populations of salmon. The National Research Council Committee on Protection and Management of Pacific Northwest Anadromous Salmonids identified habitat problems as a primary cause of declines in wild salmon runs (NRCC 1996). Some of the habitat impacts identified were the fragmentation and loss of available spawning and rearing habitat, degradation of water quality, removal of riparian vegetation, decline of habitat complexity, alteration of streamflows and streambank and channel morphology, alteration of ambient stream water temperatures, sedimentation, and loss of spawning gravel, pool habitat and large woody debris (NMFS 1998a; NRCC 1996; Bishop and Morgan 1996). Other factors such as urban growth, upland land use practices and polluted runoff, contaminants in coastal wetlands and estuaries, and dredge spoil disposal have also been identified as habitat problems contributing to the decline of chinook salmon (PFMC 1995, WGSRO 1999).

Losses of wetlands, tidal sloughs, and estuaries in heavily urbanized or industrialized river basins have been extensive. In some areas of Puget Sound, greater than 95% of estuaries and coastal wetland habitats have been eliminated since the 19th century (Sherwood *et al*, 1990; Simenstad *et al*, 1992). At the head of Commencement Bay, the vast expanse of saltmarsh, mudflats, and tidal channels, that is evident from historical maps and aerial photographs, has been almost totally eliminated by dredging and filling over the last 100 years (COE *et al* 1993).

2.1.2 Evaluating the Proposed Actions

The standards for determining jeopardy are set forth in section 7(a)(2) of the ESA and 50 C.F.R. Part 402 (the consultation regulations). The NOAA Fisheries must determine whether the action is likely to jeopardize the listed species. This analysis involves the initial steps of (1) defining the biological requirements and current status of the listed species, and (2) evaluating the relevance of the environmental baseline to the species' current status.

From that, NOAA Fisheries evaluates whether the action is likely to jeopardize the listed species by determining if the species can be expected to survive with an adequate potential for recovery. In making this determination, NOAA Fisheries must consider the estimated level of injury or mortality attributable to: (1) collective effects of the proposed or continuing action, (2) the environmental baseline, and (3) any cumulative effects. This evaluation must take into account measures for survival and recovery specific to the listed salmon's life stages that occur beyond the action area. If NOAA Fisheries finds that the action is likely to jeopardize, NOAA Fisheries must identify reasonable and prudent alternatives for the action.

Guidance for making determinations on the issue of jeopardy and adverse modification of habitat are contained in *The Habitat Approach, Implementation of Section 7 of the Endangered Species Act for Actions Affecting the Habitat of Pacific Anadromous Salmonids*, August 1999 (Appendix I).

2.1.3 Biological Requirements

The relevant biological requirements are those necessary for salmon in each ESU to survive and recover to naturally reproducing population levels at which time protection under the ESA would become unnecessary. Adequate population levels must safeguard the genetic diversity of the listed stock, enhance their capacity to adapt to various environmental conditions, and allow them to become self-sustaining in the natural environment.

Along the Hylebos waterway and within the entire action area, a variety of industrial, commercial, and shipping activities exist which have eliminated the majority of intertidal and shallow subtidal habitats. Availability of rearing habitat is important for outmigrating smolts. During their residence in the estuary, juvenile salmonids require refugia for resting, feeding, smoltification, and predator avoidance. Predation occurs throughout the life cycle of salmonids and is an important mortality agent. Many inter-dependent factors affect the magnitude of predation mortality, including the characteristics of prey, characteristics of predators, and characteristics of the environment (e.g. habitat, and environmental stresses such as contaminant stress). Mortality during early marine life is often quite high with mortality rates up to 77% occurring during the first several days of life in saltwater (Salo *et al* 1980).

Multiple stress factors will have incremental effects on the species, adding to the overall stress encountered throughout their life stages. The effects of any one factor for decline can be complicated by the influence of others. For example, if a population was exposed to a prolonged series of high temperatures, lowered dissolved oxygen (DO), and/or water borne contaminants, it may be more readily infected with disease organisms that further weakens its resistance to new temperature, DO, and/or contaminant exposures, or other physical or biological factors (Arkoosh *et al* 1998a & 1998b). This exposure can leave the population weakened from energy depletion through inadequate food intake, high metabolic costs, and negative growth. The probability of increased mortality from predation, disease and competition in these cases is greater than when a population is confronted with only one factor for decline.

For reasons discussed in more detail below, the biological requirements of salmonids in the action area are affected by multiple stressors. They include loss of nearshore habitat, altered light regimes, limited prey resources and poor water and sediment quality. Commencement Bay and the Puyallup River and delta have undergone extensive, cumulative, adverse, physical and ecological changes to which juvenile salmonids have evolved (Simenstad 2000).

2.1.4 Environmental Baseline

The environmental baseline represents the current set of basal conditions to which the effects of the proposed action are then added. The term “environmental baseline” means “the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process.” 50 C.F.R. § 402.02.

NOAA Fisheries is familiar with numerous activities that influence the current environmental baseline conditions in Commencement Bay including expanding urban development, railroads, shipping, logging, agriculture and other industries. Continuing habitat alterations such as dredging and relocation of the Puyallup River, construction through dredging of waterways for the purposes of navigation and commerce, steepening and hardening formerly gently sloping and/or soft shorelines with a variety of material, and the ongoing development of the Port of Tacoma and other entities has resulted in habitat loss. Marsh areas have been filled for commercial uses, residences, barns and roads. Contaminated water and sediment from industrial and domestic discharges have also altered or destroyed habitat. Dredging, diking, and channeling the Puyallup River altered the suitability of habitat for wetland and aquatic plants, benthic invertebrates and for listed salmonids (USFWS and NOAA, 1996). In addition, the current distribution of salmonids in the Puyallup basin is affected by dams and hydropower operations, and other artificial or natural features that diminish passage to their spawning grounds. Distribution has also been limited by watershed hydraulic changes and other habitat modifications.

Land-use in the Puyallup River watershed cumulatively contributes to the degradation of water quality in the river, which is then carried to its mouth and into Commencement Bay. Recent monitoring studies by the U.S. Geological Survey in 23 urban streams in the Puget Sound basin routinely found a diverse mixture of insecticide, herbicides and other biocidal compounds (Scholz *et al* 2000; U.S. Geological Survey 1999). Diazinon, a commonly used organophosphate, has been shown to disrupt antipredator and homing behavior in chinook salmon when found in environmentally typical concentrations (Scholz *et al* 2000).

Commencement Bay is an estuarine embayment adjacent to the deep, fjord system of south-central Puget Sound. It is generally defined as the geographic region of south Puget Sound extending from Brown's Point to Point Defiance. The waters are deep throughout the entire bay, ranging from 73.8 feet. at the head of the embayment, to 531.7 feet. at the entrance (David Evans and Associates1991 in COE *et al* 1993). The waters shoal abruptly at the head of the bay to the remnant mudflats, which are exposed at low water. In addition to the marine water influence from Puget Sound, there is significant freshwater input into the bay. The Puyallup River and Hylebos and Wapato Creeks contribute considerable flows and a proportionate amount of sediment to the bay.

The flow of the Puyallup River (mean annual discharge of 3,315 cubic feet per second [cfs]) is a significant source of fresh water to the estuary. The temperature, salinity, DO, and turbidity of the bay can fluctuate widely because the freshwater inflow can range from 306 cfs to 57,000 cfs. Given this range, the salinity in waterways, like the Hylebos Waterway, can vary widely depending on the location, depth, tide, and season (COE 1981). Tides are of the mixed type with two unequal highs and two unequal lows each day. The tidal range is from about +11.8 feet. (MHHW) to -4.5 feet. (MLLW).

A limited number of mudflats remain and are scattered throughtout the waterways and inner parts of the bay. Between 1877 and 1990, filling of mudflats and emergent marshes, channelization of the Puyallup River and dredging of the waterways have significantly changed the extent, configuration and distribution of estuarine habitats in the Bay. Eleven percent (187 acres) of the intertidal mudflats remain whereas one percent (57 acres) of the emergent wetlands exist (COE *et al* 1993). Historically, emergent marsh vegetation in the Puyallup delta covered between 2,471 and 2,539 acres (David Evans and Associates 1991). A recent survey of the existing estuarine habitat in Commencement Bay from the southern end of Ruston Way to the northern end of Brown's Point reports a total of 27.9 miles of shoreline and 532.2 acres of intertidal and shallow subtidal habitat (Pacific International Engineering 2000). About 5.0 miles of the shoreline are covered with over-water structures (30 acres) and 1.8 miles are obstructed by bulkhead. The substrate composition of the intertidal and shallow subtidal habitat is predominantly fine grain material but also includes a significant amount of shoreline armoring, like riprap (17%). A large portion of this habitat has slopes typical of estuarine mudflats.

The Hylebos Waterway contains a large portion of the remaining nearshore habitat in

Commencement Bay. The Hylebos Waterway shoreline makes up 28% (7.7 miles) of the shoreline in the action area. The waterway's shoreline currently has 3,899 feet covered by about four acres of overwater structures and 1,760 feet. of shoreline with bulkheads (vertical wood or sheet pile walls usually placed in the intertidal zone). About 127 acres of intertidal and shallow subtidal habitat exists in Hylebos Waterway, of which 13.5 acres (11%) are either riprap or other manmade surfaces (e.g., asphalt or concrete), 15 acres (12%) are characterized by gravel to mixed fine substrates, 10.3 acres (8%) are composed of sand substrates and 88.3 acres (69%) are mud substrates (Pacific International Engineering 2000). Most of the intertidal habitat has a gradual slope. About 44% of the waterway has less than a 10-1 ratio slope and 39% of the waterway has between a 10-1 ratio and 2-1 ratio slope. Over half (61%) of all mudflats in Commencement Bay are found in the Hylebos Waterway. This is significant in that mudflats have some of the highest abundance of juvenile salmonid prey of the nearshore substrates. Another significant resource feature is that the waterway also contains one of the few locations in Commencement Bay with larger patches of estuarine emergent wetland. In 1980, the National Wetland Inventory, a national wetlands mapping effort using high altitude aerial photography, shows that the Hylebos Waterway contained 1.03 acres of estuarine emergent and 4.61 acres of estuarine aquatic bed (mudflat) wetlands. This same inventory found no other estuarine emergent or aquatic bed wetlands associated with other waterways in Commencement Bay.

The distribution of subtidal habitat in the waterways has changed along with a change in the depth distributions. There has been a trend toward wider, deeper waterways with engineered side slopes resulting in waterways with a greater proportion of deeper water than shallower water and reduced intermediate depths typical of a natural slope. The Blair Waterway is a prime example of such deepening (USFWS 1996). In the 1980s, about 30% of the waterway was less than 30 feet deep. Now, that figure is about 15% of the waterway. This condition is expected since the waterways are anthropomorphic features designed for commercial shipping and with width, length, depth, and side slopes optimized for this purpose. This change in depth may be significant to salmonid life history because it tends to simplify the available refugia by reducing the intermediate depths typical of a natural slope.

The lower Puyallup River, including its delta, and Commencement Bay, is one of the most modified and highly stressed natural systems in the Pacific Northwest (Simenstad 2000). This has forever altered the life-support opportunities of the lower river and estuary for juvenile chinook and other salmonids, and has affected its use. Despite the significant degradation of the Puyallup River and Commencement Bay estuary, anadromous fish remain reliant upon the remaining habitat functions.

Historically, juvenile salmon utilization of the Puyallup River delta/Commencement Bay estuary complex was likely prolonged and widely dispersed (Simenstad 2000). The once extensive tidal-freshwater floodplain, considerable side channel, relict oxbow and other low-energy environments provided great opportunities for ocean-type chinook to conduct their necessary life-history strategies. Within the freshwater-brackish or oligohaline reach of the estuary, ocean-type chinook had the opportunity to occupy low-energy side-channel and marsh habitats and osmoregulate in order to survive the saltwater phase of their early life-history. Also, chinook and other types of salmon (pink and chum) had considerable opportunities to move into expansive emergent marshes of the delta, where they could reside in complex dendritic tidal channel systems. As is evident from sampling efforts of Duker *et al* (1989) and the Puyallup Tribe of Indians (PIE 1999), juvenile subyearling salmon fry and small fingerlings likely would have stayed within the influence of the river's buoyant turbidity plume or in shallow water.

In addition to the expanse of transitional habitats providing opportunities for physiological adaption and refuge from predators, the historical habitats of the Puyallup River delta/Commencement Bay estuary complex would have produced an abundance and diversity of food organisms favored by juvenile salmonids. The tidal floodplain's freshwater wetlands, side-channels, and riparian complexes would have generated a multitude of insects, both as aquatic larvae and pupae, and as adults. These are prominent components of juvenile salmon diets as they emigrate from fresh to brackish water. Shallow-water, vegetated tidal-freshwater, brackish, and oligohaline marshes, and to a lesser degree mudflats, are notable for high production of dipteran flies, aphids, and other insects characteristic of salmon diets prior to entering more euryhaline habitats (Levy and Northcote 1982). In the more euryhaline marshes and mudflats, benthic and epibenthic crustaceans are more important prey of juvenile salmon. Certain taxa of gammarid amphipods, harpacticoid copepods, isopods and mysids, often preferred prey, are characteristic of marsh vegetation, fine, muddy sediments and tidal channels. Only as salmon move to more open water as larger smolts do they rely on planktonic prey. However, studies by Simenstad *et al* (1985) showed that juvenile chinook continue to feed upon surface drift insects or neustonic drift, exported by the Puyallup River even when they were in open waters of the bay.

Investigations of epibenthic invertebrate communities in Commencement Bay have been limited (Simenstad 1993). Sampling incongruities, such as temporal and spatial limitations, have made data comparisons difficult. The majority of the studies focused on evaluating areas as suitable juvenile salmonid prey habitat with little consideration given to the effects of losses of intertidal and shallow subtidal habitat, and chemical and organic contamination on the whole epibenthic community. Epibenthic taxa considered reliable indicators of natural assemblages, and vulnerable to persistent habitat alterations do not show any consistent time-series trend in their occurrence in the waterways. However, when compared to other estuaries, Simenstad *et al* (1985) infer that the normal epibenthic resource base in the Puyallup River estuary may be deficient to the degree that juvenile salmon may be forced to supplement their diets with alterative prey such as drift insects.

In their review of sparse, past data-sets on epibenthic sampling in Commencement Bay, Cordell and Simenstad (1988) identified several trends that enabled them to speculate in historical changes:

1. The data consistently show a trend toward higher taxa richness and species diversity at lower intertidal and shallow subtidal, as opposed to higher intertidal habitats. This may be due not only to the greater exposure time of the higher habitats, but to the beach substrate and slope (very much related). Lower gradient portions of the beach are more

conducive to epibenthic production than are higher gradient sections because the lower the slope, the higher the retention of water and organic matter (detritus) which supports small epifauna. Therefore, loss of low gradient shoreline and replacement with a high gradient structure (upper intertidal habitat) probably represents a loss of epibenthic production.

2. In two studies reviewed by Cordell and Simenstad (1988), where comparisons were made between a uniform hard substrate (rip rap) and adjacent "natural" substrates, taxa richness and density were lower on the hard substrate. The authors infer that replacement of soft or unconsolidated sediment with rock probably results in decreased epibenthic production.

3. Stressed epibenthos communities existed, or still persist, in certain waterways which have been both acutely and chronically contaminated and do not have a regular rate of sediment accretion from sources such as the Puyallup River. The Hylebos waterway does not benefit from sediment accretion. Benthic and epibenthic populations in the vicinity of the project have been characterized as moderately to severely stressed (David Evans and Associates 1991).

4. Compared to the historic habitat structure of the Puyallup River and Commencement Bay estuary, which was composed almost exclusively of low-gradient, fine unconsolidated sediment mudflats and salt marshes, the high-gradient, coarse sediment, vertical hard-substrate habitats and light inhibited areas that now prevail do not support the historic complexity and production of epibenthic crustaceans.

As an area with a long industrial history, hazardous substances have been released into Commencement Bay over the last century, including chlorinated compounds, aromatic hydrocarbons, trace metals, dioxins, furans, and phenols. Concentrations 100 to 1,000 times greater than reference areas in Puget Sound were measured for 28 contaminants or contaminant groups (Tetra Tech 1985). The Commencement Bay/Nearshore Tideflats Superfund site, a 12 square mile area, was listed by the Environmental Protection Agency (EPA) on the National Priorities List (NPL) in 1983. This action focused federal attention on the bay resulting in some significant steps in the last decade to reduce contaminant sources and to clean up the bay's contaminated areas. The bay is also included on the Washington State Department of Ecology's 303(d) list of impaired water bodies. Among the high priority contaminant issues are the bay's levels of arsenic, lead, mercury and zinc.

Specifically, the Hylebos waterway is severely contaminated with a variety of organic and inorganic contaminants. When EPA identified their high-priority NPL sediment contamination sites in 1983, the head and mouth of the Hylebos waterway were included. EPA included polychlorinated biphenyls, polycyclic aromatic hydrocarbons, DDT, hexachlorobenzene, heptachlor, and several pesticides as some of the sediment contaminants of concern. In a study investigating the trends in metal concentrations in the waterways, the Hylebos waterway exhibited the highest water concentrations of copper, arsenic, cadmium, lead, mercury, chromium, and nickel of all the waterways and Commencement Bay. While metals water concentrations in the Hylebos waterway have not been identified as concerns under the EPA Superfund program, patterns of contamination are apparent (Johnson and Summers 1999).

The present conditions include numerous effects on the listed species. Where Commencement Bay had once offered an extensive estuary with tidal channels with clean water and sediment for rearing, resting, feeding and refuge, the current baseline condition is significantly limited. The loss of estuarine habitat through bank hardening, construction of overwater structures, waterway deepening and side-slope steepening, increased erosion due to boat wakes, and sediment and water contamination limits areas for resting, rearing, feeding, and avoiding predation. Taken together, these conditions increase the risk of predation and lowered growth rates for emigrating juveniles when compared to fish not confronted with these limiting factors. The degree of these risks is moderate to high. Currently, the water quality and habitat indicators are in a "not properly functioning"condition.

2.1.4.1 Status of the Species in the Action Area

Artificial propagation programs constitute the dominant salmonid population in the Puyallup River. The White River spring chinook population, which is listed as critical by state and tribal fisheries managers, now depends largely on some degree of artificial production, such as the Muckleshoot White River Hatchery (SASSI, 1992). The White River spring chinook stocks have lately experienced a tenuous rebound as escapement has steadily increased from the historic lows of the 1980s. Non-tagged returns of White River spring chinook adults in 2000 was 1,732 individuals. This was the largest documented return in over 30 years. This increase is consistent with larger numbers of chinook in the Columbia River during 2000, indicating good ocean survival (Tynan, pers. comm. 2000).

The above discussion not withstanding, the paucity of data makes it difficult to determine the status of Puget Sound chinook within the action area. Overall abundance of chinook salmon in this ESU has declined substantially from historical levels, and many populations are small enough that genetic and demographic risks are likely to be relatively high (63 Fed. Reg. 11494; March 9 1998). Escapement of Puyallup River/White River chinook are moderate in comparison to escapement data from other runs within the Puget Sound ESU. Recent 5-year geometric mean spawning escapement for the Puyallup River/White River average around 1,000-10,000 fish. Both long- and short-term trends in abundance are predominantly downward, and several populations within this ESU are exhibiting severe short-term declines (63 Fed. Reg. 11494; March 9 1998). Trends in estimated abundance of the Puyallup River/White River chinook appear to be increasing from 1-5%. However, according to Nehlsen and workers (1991, in Myers et al, 1998) these stocks pose special concern and moderate extinction risk, respectively.

Three runs of chinook salmon inhabit the Puyallup River basin including a spring run in the White River, a summer/fall run in the White River, and a fall run in the Puyallup River (SASSI, 1992). Chinook salmon of the Puyallup River basin exhibit primarily ocean-type life history strategies, with smolts migrating to the ocean during their first year, maturing at ages three and four, and having coastal-oriented ocean migration patterns (Myers *et al.*, 1998). Puyallup River fall run chinook salmon were listed by state and tribal fisheries managers as a stock of special concern and spring chinook are considered to be nearing extinction (Salo and Jagielo, 1983, *in* Parametrix, 2000). Glacial melt waters typical of the Puyallup River make it difficult to conduct spawner surveys. Resource managers have had to rely on returns to an index area on South Prairie Creek, tributary to the Carbon River, to model chinook spawning in the Puyallup River.

The summer/fall run of chinook salmon in the White River is distinct from the spring run based upon run timing, and distinct from the fall run based on geographic distribution of spawners. In the lower White, lower Clearwater, and lower Greenwater Rivers, spawning occurs from late-September through October (Salo and Jagielo, 1983 *in* Parametrix, 2000; SASSI, 1992). The summer/fall chinook stock is considered wild and the stock status is unknown due to inconsistent spawner counts (SASSI, 1992).

Puyallup River fall chinook salmon are distinct from other chinook runs based on their run timing and spawning distribution, which occurs in the Puyallup River upstream of the town of Sumner, and in tributaries including the Carbon River, South Prairie Creek, Wilkeson Creek, Voight Creek, and Clarks Creek (SASSI, 1992). Fall chinook primarily spawn from September through October, with most natural production occurring in South Prairie Creek. Non-native hatchery chinook releases into the Puyallup River have been made since the 1960s primarily with Green River stock. Recent Puyallup River screw trap data showed the peak out-migration occuring in early June (2001), with limited numbers of fish caught as late as the end of July (Ladley pers. comm. 2002). Status of the fall run chinook in the Puyallup River is unknown due to inconsistent spawner survey data (SASSI, 1992).

2.1.4.2 Factors Affecting the Species in the Action Area

The biological requirements of the listed species currently are not being met under the environmental baseline over the ESU. Declines in relative abundance for Puget Sound chinook may be attributable to extensive agricultural, port (including industrial and commercial) and, residential development, as well as flood control over the past 150 years. To improve the status of the chinook, significant improvements in environmental conditions are needed.

To evaluate the factors affecting the species covered in this biological opinion, the NOAA Fisheries assesses pathways and indicators of ecological functions necessary for fish, otherwise known as the Matrix of Pathways and Indicators (MPI). Pathways are major categories of habitat elements. Water quality, physical habitat, and habitat access are examples of pathways. The indicators are elements of pathways. For example, indicators for water quality include temperature, sediment, and chemical contamination. A general MPI for estuarine/marine environments has not been fully developed. For this analysis, NOAA Fisheries adapted the MPI originally developed for similar assessments in the forested environment. The pathways that are included in the analysis under the proposed action include water quality, physical, and biological habitat. These pathways are suggested for analysis because of the potential that the activities underlying this proposed action are likely to affect them. The MPI approach provides the assessment tool to evaluate the current environmental baseline condition against which to analyze the effects of the action.

In the action area, specific factors that may affect the quantity and quality of habitat for chinook include: modified shoreline substrate composition and slope, preferred prey abundance and accessibility, habitat access, shade and light effects, and water and sediment quality. For example, an indicator for habitat quality in the brackish oligohaline portion of the lower Puyallup River, would be the lack of habitat remaining for chinook to reside and transition from fresh to salt water.

The shoreline substrate along the north shore of the action area out to Brown's Point and the south shore to Point Defiance is comprised of a mix of materials. Native substrate can be described as shallow gradient beaches with mud and sand substrate, emergent marsh at upper elevations, some eelgrass at low-tide elevation, and larger-sized material at high tide levels (Duker *et al* 1989; Shapiro and Assoc. 1992). As described above, native substrate is limited due to hardening of shorelines, deepening, wake caused erosion, and construction of overwater structures. The typically productive biological and ecological attributes of an intertidal and shallow subtidal beach have been significantly diminished throughout most of the action area, however, the project site contains remnant emergent marsh and mudflat characteristics.

The effects of shoreline modifications on preferred prey species have been studied (Ahn and Choi 1998; Gilmore and Trent 1974; Simenstad *et al* 1991 in Williams and Thom 2001). However, the effects of overwater structures on benthic and epibenthic prey species has not been well studied. When Parametrix (1991) compared the impacts on total epibenthos and prey epibenthos of pier aproned and non-pier aproned stations, they found significantly higher epibenthos abundance at the non-pier apron stations. However, the results were less concise than anticipated due to lack of control of substrate and slope variables. While Parametrix (1991) determined epibenthos abundances under pier aprons ranging from 84% to 86% of that under non-pier apron station, the Washington Department Fish and Wildlife (WDFW) refutes the findings. The WDFW analysis of the same dataset found errors in the earlier interpretation of the data and determined epibenthos abundances under pier apron stations in the order of 50% of non-pier aprons (Carmen pers. comm. 2001). In a recent study assessing the differences in epibenthic fauna between areas directly underneath and removed from large over-water structures, highly significant differences for both total epibenthic and salmon prey organism densities at all three terminals were found, indicating negative impacts of overwater structures (Haas pers. comm. 2002).

The effects of overwater structures on the ability of salmonids and other fish to access and utilize the habitat has been studied in some detail. Over-water structures and armoring are considered to affect survival and migratory success of juvenile salmon by forcing them into deeper water where predator exposure is increased and food resources are limited (Thom *et al* 1994; Simenstad *et al* 1999). Similarly, cage studies on the Hudson River estuary showed that juvenile fish had negative growth under large municipal piers (Duffy-Anderson and Able 1999). This negative growth occurred despite the apparent availability of appropriate prey, indicating that it was too dark under the piers to successfully forage. Inadequate growth rates can lead to higher rates of mortality. Based on these and other experiments, under-pier environments are poor-quality habitats for some species of juvenile fish.

Much of the shoreline in Commencement Bay has been shaded by pier aprons. Studies of the under-pier ecology of juvenile pacific salmon in Commencement Bay by Ratte and Salo (1985), showed that chinook preferred not to go into the dark zone under piers to use the shallow riprap areas. Fish abundance and species richness are typically low under piers (Parametrix 1991; Able *et al* 1998). Instead, most of the juveniles preferred to use the pier edge. Juvenile chinook are visual feeders. While some epibenthic prey exist under the piers in the nearshore shallows, the darkness creates very poor feeding conditions, similar to that found in the Hudson River studies. Juveniles found in the Hylebos waterway, are more likely to feed on planktonic diet (Simenstad *et al* 1985; Simenstad *et al* 1999; Simenstad 2000). If epibenthic prey resources in the nearshore environment were available, they most likely may not be utilized by juvenile chinook.

Light measurements taken by Ratte and Salo (1985) under the Terminal Four in Commencement Bay suggest that the ambient light conditions at a three-foot depth are adequate for active salmonid schooling and feeding. However, exploring the limits of the equipment used, NOAA Fisheries and the USFWS found that the analog meter and sensor employed for the study had a resolution (error reading) of plus or minus (+/-)0.05 foot candles. The lower light levels reported by Ratte and Salo (1985) are lower than the "noise" that can be resolved by the instrument (Karmazin pers. com. 2001).

Moreover, the product literature from the manufacturer (LI-COR) indicates that the stability of the sensor decays at a rate of +/- 2% over a one year period. The age of the sensor used by Ratte and Salo (1985) is not indicated, but when asked, the author thought that it was a couple years old. The accuracy of the sensor therefore, was likely lower than expected. This implies that the light measurements taken under Terminal Four could, in fact, have been zero. NOAA Fisheries believes that light levels under such industrial piers are low enough to preclude feeding and migration of juvenile chinook.

Water and sediment contaminants have been associated with a variety of effects on migrating salmonids and their prey resource (Ecology 1991; Spence *et al* 1996; Varanasi *et al* 1993; Stein *et al* 1995). Collier and workers (1998) found that juvenile chinook from the Hylebos Waterway were clearly showing increased exposure to a wide range of chemical contaminants, compared to fish from hatcheries or reference sites. In addition, the levels of exposure were comparable to levels which has been shown to cause impaired growth, immunosuppression, and increased mortality following pathogen exposure (Collier *et al* 1998; Arkoosh *et al* 1998c). In a Puget Sound-wide benthic invertebrate study, elevated levels of sediment contamination have been associated with fluctuations in certain species of benthic invertebrates (Llanso *et al* 1998). It is NOAA Fisheries' opinion that those juvenile chinook that rear in the Hylebos waterway are exposed to levels which will directly and indirectly hinder their ability to grow and may possibly increase mortality levels.

2.1.5 Effects of the Proposed Action

NOAA Fisheries' ESA implementing regulations define "effects of the action" as "the direct and indirect effects of an action on the species together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline." "Indirect effects" are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur (50 C.F.R. 402.02). To evaluate direct and indirect effects associated with the proposed project, NOAA Fisheries addresses the elements of the life history of Puget Sound chinook as they relate to the action area and the proposed project.

To evaluate direct and indirect effects associated with the proposed project, it is critical to address elements of the life history of Puget Sound chinook. Commencement Bay has been used as a rearing and migration corridor for juveniles and adults. Natural spawning has been documented in the Puyallup River (SASSI 1992; Simonstad *et al* 1982; Simonstad 1997). The limited shallow water habitat in the action area raises questions about the present day use of the area for rearing (Simenstad *et al* 1993; Simenstad 2000). However, shallow habitat beaches at the proposed site, as well as to the south and west (near the mouth of the Puyallup River and towards Point Defiance, respectively) and from the mouth of the Hylebos waterway north to Browns Point, as well as some of the riprap slopes, although limited in amount, appear to contribute to various ecological functions for rearing. The Puyallup River plume also contributes to the amount of available rearing habitat. In large part, the plume provides juvenile salmonids one of the remaining areas to osmoregulate from fresh to marine water.

The operation of the proposed wharf, and associated habitat enhancements are likely to adversely affect Puget Sound chinook. The project will produce long-term effects such as the permanent loss of functional nearshore habitat to juvenile Puget Sound chinook from shading by the proposed wharf at the project site. Shading will cause the limitation of productivity of epibenthic invertebrates and the movement of early juveniles offshore due to the light/dark interface at the proposed wharf edges. Additional long-term effects include bottom scour from the barge and tug boat traffic, potential migration delays due to the altered light regimes caused by on-wharf, directional lighting, and exposure to heightened levels of organic contaminants from untreated stormwater runoff and loss of wood chips from the conveyor to the aquatic environment. However, the proposed project includes habitat enhancements in the form of creation of an intertidal and upper intertidal beach on a peninsula in the Hylebos Waterway and enhancement of a portion of the project site that will offset numerous adverse effects and potentially provide beneficial effects to Puget Sound chinook. Monitoring programs will be employed to determine the efficacy of the minimization and enhancement efforts.

2.1.5.1 Direct Effects

Direct effects are the immediate effects of the project on the species or it habitats. Direct effects result from the agency action and may include the effects of interrelated and interdependent actions. Future Federal actions that are not a direct effect of the action under consideration (and not included in the environmental baseline or treated as indirect effects) are not evaluated.

Generally, direct, short-term effects of the project link the timing of rearing and migration of juvenile Puget Sound chinook to the timing, extent, and duration of the in-water construction activities. The short-term effects (migration delays due to noise, migration and rearing effects due to turbidity, disturbance of prey base) on out-migrating juvenile chinook from this proposed project will be minimized by limiting the proposed construction to the period from August 16 to February 15 of any year. While juvenile chinook have been collected as late as mid-September in Commencement Bay, it is presumed that those juveniles have been residing and growing in the estuary for a number of months, hence, they are larger in size and less dependent on nearshore habitats for refuge and rearing. Thus, NOAA Fisheries concludes that the effects of construction during the late summer through mid-winter construction will be insignificant and discountable.

Long-term direct effects of the action include 1) shading from the overwater structure affecting the limitation of productivity of epibenthic invertebrates, the movement of early juveniles offshore, and potential migration delays due to the altered light regimes caused by on- wharf lighting, 2) additional habitat capacity due to the creation of upper intertidal beach in the Hylebos Waterway and the enhancement of the beach on-site, 3) the occurrence of take as a result of monitoring, and 4). exposure to heightened levels of organic contaminants from untreated stormwater runoff and loss of wood chips from the conveyor to the aquatic environment.

2.1.5.1.1 Shoreline Shading and Lighting Effects on Migration and Prey Production

Under the current conditions, the site does not present shoreline shading effects as it is comprised of an intertidal mudflat. The proposed wharf will shade 15,935 square feet of intertidal and upper intertidal beach and the proposed dolphins and catwalks will shade an additional 1,465 square feet area. In addition, log and chip transport barges will take up to a maximum of 30,000 square feet of subtidal habitat from - seven feet. MLLW to -20 feet. MLLW. The proposed wharf will cause direct long-term effects on epibenthic invertebrate production and juvenile migration. It will affect ecological functions supporting juvenile salmonids by blocking the sun and extending a dark shadow over the nearshore migratory zone and prey source. The area that will be shaded is composed primarily of mudflats with a small plot (approximately 745 square feet) of pickleweed. Currently, the site may present night-time lighting effects as the uplands serve as a functioning wood products facility processing wood chips and logs.

The effects of shading on migration will be off-set through the creation of a 4,640 square foot wharf window, provision of a 10 foot width of grating in the 20 foot wide western pier, and installation of artificial lighting under the proposed wharf. The artificial lighting will mimic ambient light and will operate from one-half hour before dawn to dusk each day during the months of March through June. Monitoring will determine the effectiveness of this experimental program. Effects to the food web will be off-set through the creation of the intertidal beach off-site and the enhancement of the intertidal beach on-site. Transplanting the pickleweed patch into an area double its existing area has the potential to provide twice the amount of detritus contributing to primary and secondary production. The artificial lighting program may also offset food web effects of the proposed wharf.

Wharfs and piers can present sharp underwater light contrasts by casting shade during ambient daylight conditions, as well as casting light during ambient night-time conditions. The direct effect of this shading in shallow water habitats on juvenile chinook salmon will to shift normal migration behavior, feeding, and refuge from potential predators. Studies summarized by Simenstad *et al* (1999), repeatedly verify that changes in the underwater light environment affect juvenile salmonid physiology and behavior. The authors found that the responses of juvenile salmon were extremely size-dependent. The smaller the fish, the more their migration appeared to be behaviorally constrained to the shallow water habitats, and the more likely they were to avoid entering shaded habitats.

Furthermore, salmon fry tend to use both natural refuge (e.g., vegetation such as eelgrass) and darkness (e.g., shading from docks and floats and turbidity) as refuge but migrate along the edges rather than penetrate them (Simenstad *et al*. 1999). In addition, while prey organisms will still be produced on the mudflats below the wharf, they will be produced at a significantly lower rate than without the shade (Haas pers. comm. 2002), and to the extent that these organisms are still present, their availability to, and utilization by juvenile chinook will be significantly reduced (Simenstad *et al* 1985; Simenstad 2000).

Nightingale and Simenstad (2001) and Simenstad et al. (1999) provides the most current synthesis on the effects of piers on salmonid behavior, habitat and predation. Their work included most sources on over-water structure, its emphasis was on ocean-type juvenile salmonids (30 to 60 mm in size). The report also summarizes literature for larger salmonids, like sockeye, coho and steelhead. The authors acknowledge that they expected to find ambiguous information and interpretations in the literature, but sought to identify factual bases for the differing observations.

Their literature synthesis resulted in the following findings:

1. Over-water structures create sharp underwater light contrasts by casting shade over an area during the day. Light contrasts can also occur at night from artificial lighting surrounding a structure. These light contrasts could result in delays in migration caused by disorientation, the dispersal of fish schooling in salmonid refugia under light-limited conditions and an increased size-selective predation risk due to a change in migratory routes to deeper waters to avoid light changes;

2. No studies are available that described empirical evidence supporting or refuting that modification of juvenile salmonid behavior in shoreline habitats resulted in changes in survival. Results were exceedingly variable and appeared to reflect the study conditions;

3. Despite considerable speculation that over-water structures increase predation, evidence supporting this contention is inconclusive. Quantitative assessment of predation around over-water structures is meager and few studies have confirmed actual predators; and

4. Light is extremely important in determining the type and distribution of diatoms, photosynthetic bacteria, phytoplankton, macroalgae, microalgae and seagrasses. Over-water structures can reduce light to levels that are 90 to 100% below ambient, significantly affecting marine plant distribution and abundance.

Nightingale and Simenstad (2001) also came to a number of conclusions that are very relevant to this project. They explained that cumulative impacts in urban industrialized areas in estuaries (multiple placements of overwater structures) can pose substantive risks to estuarine ecosystems, especially in areas like Commencement Bay where estuarine habitat is extremely limited and the shoreline is highly modified with piers and bulkheads. This synthesis suggested using a landscape ecology approach to address cumulative impacts by combining increased light in under-pier environments with adjacent areas of enhanced prey productions. Such an approach would begin to rebuild a higher carrying capacity migratory corridor for juvenile salmonids, that typically suffer higher mortality during migration. In addition, they identified a number of specific recommendations for assessing light limitations, minimizing under-dock light levels to avoid fish behavior interference and maintain vegetative growth, and allowance of over-dock light s spectra (Nightingale and Simenstad 2001).

Not all of the chinook migrating out of the Puyallup River will experience the proposed wharf. Analysis of the Puyallup Tribe of Indians beach seine data (PIE 1999) suggests that less than half of the population entering the bay will encounter the proposed structure. Of the fish that migrate near the proposed wharf, many will be of sufficient size that swimming offshore will not likely affect their survival. NOAA Fisheries' concern rests with those smaller juveniles that are very nearshore dependent.

The Hylebos Waterway is moderately used by Puyallup River out-migrating juveniles (PIE 1999) in contrast to heavy use of other waterways. These fish will benefit from the proposed intertidal beach creation located to the west of the proposed wharf as well as the beach enhancement located to the east. In addition, spawning surveys conducted by the Washington Department of Fish and Wildlife indicate that chinook salmon have been found in Hylebos Creek. The sightings have been sporadic and extremely limited with one to two fish found in 20 surveys. Nonetheless, the few out-migrants from the Hylebos Creek will also benefit from the proposed intertidal beach creation and the beach enhancement sites. If Puyallup River chinook forego migration along the Hylebos Waterway shoreline by crossing the waterway at its mouth, and if the Hylebos Creek chinook migrate out of the waterway along the south shore of the waterway, both stocks will encounter the proposed wharf prior to or without encountering the proposed intertidal beach, respectively. It is not known whether the avoidance of the darkened, shallow nearshore area under the proposed wharf will directly affect the juveniles' survival and recovery. The proposed intertidal created beach and the enhancement of the beach on-site have the potential to provide sufficient offsets to the effects of the proposed wharf. Chinook and forage fish will benefit from the creation and enhancement of these beaches due to their replacement of rearing and feeding habitat in the tidal zone of Commencement Bay.

Simenstad *et al* (1999) found that the scale of light is also a factor. When migratory pathways are blocked by shaded or other less preferred habitat, competing behavioral responses appear to result in fish confusion and often in delay of active migration. Because of these concerns, the Edman Holdings company has agreed to undertake a number of conservation measures to minimize the effects of the proposed wharf. The Edman Holdings company is proposing to create a 4,640 square foot wharf window, provide 10 feet of grating in the 20 foot wide western pier, and to install artificial lighting under the proposed wharf that would operate from one-half hour before dawn to dusk each day during the months of March through June (the peak of the out-migration period). The wharf window and grating will allow the penetration of ambient light through the western section of the wharf. The intent of the lighting program would be to mimic, with artificial lights, the amount of sunlight present along the intertidal shoreline. The program is considered experimental, and while the design has not yet been developed, the goal would be to provide enough light to allow passage of out-migrating juveniles. A monitoring program will be developed to assess the success of the lighting program. This information will prove extremely valuable for increasing our understanding of the ability of artificial lighting to offset effects on migration of over-water structures.

Shading also affects the food web by affecting primary productivity, which in turn affects secondary production. The construction of the proposed wharf over the intertidal mudflat and placement of rip rap along the shoreline slope will effectively eliminate the production of diatoms and algae and foreclose any future potential for upland vegetation to establish. Decreases in light energy limits photosynthesis of diatoms, benthic algae and associated epiphytes and other autotrophs (Simenstad 1997; Simenstad *et al* 1999). The loss of diatoms and algae, and the ability of upland vegetation to establish and grow reduces the food web inputs. The food web is a critical component of the existing ecological functions necessary for juvenile salmonid growth and survival, as well as the future ecological potential of the site.

The effect of night-time lighting has been shown to have varying effects based on factors such as light level and type. Wharfs and piers present sharp underwater light contrasts by casting light during ambient night-time conditions. Some studies of the effects of light levels on migration have shown a high sensitivity of target fish. Downstream migration of chum salmon fry was stopped completely by the light of a bright full moon (intensity level 0.006 to 0.008 lumen/sq. ft.) (Salo 1991). Tabor *et al* (2000) determined that downstream migration of sockeye was delayed by lighting of 0.02 lumen/sq. ft and was stopped completely by lighting of 1.0-1.4 lumen/sq. ft. Other studies determined that fish respond differently to light if they have had prior exposure, than if they have not. Pinhorn and Andrews (1963) found that treatment fish that had been exposed to lights prior to the experiment did not respond nearly as strongly to exposures ranging from 0.1 foot candle (ft-c) (1 ft-c = 1 lumen/sq. ft.) through 200 ft-c as did control fish. Light exposed fish were very active at all light intensities and exhibited some surfacing behavior (Pinhorn and Andrews 1965). In comparison, the control fish reacted only slightly, were very quiet at low light intensities, and remained on the bottom of the aquarium. At the highest intensity, the control fish darted out of the light immediately after the light was turned on and stayed away (Pinhorn and Andrews 1963).

Prinslow *et al* (1980) found that light levels as low as 2-13 lux did not increase salmonid catch, although those levels did congregate juvenile chum salmon. Wickham (1973) and Puckett and Anderson (1987) found fish to be attracted to mercury lights under certain conditions. During night tests, Puckett and Anderson (1987) found that steelhead initially avoided a mercury light, then swam toward it. The strength of the attraction to a solid, non-flashing light is dependent upon the intensity of the light and the level of light to which the salmonids have been previously acclimated. The increased risk posed by light changes could result from the following (Simenstad *et al* 1999):

- delays in migration caused by disorientation;
- loss of schooling in refugia because of fish school dispersal under light limitations;
- a change of migratory route into deeper waters, without refugia.

NOAA Fisheries seeks to minimize the effects of artificial light on night time fish behavior. However, NOAA Fisheries is not familiar with the current level of ambient night-time light in the Hylebos Waterway, nor about the type and amount of light to be provided on the proposed wharf. An amendment to the BE stated that "lighting will be provided as needed for safe operations." Ideally, the proposed wharf should be designed to reduce the amount of light that hits the water to no more than the ambient light levels. As identified in the terms and conditions below, Edman Holdings will determine the range of pre-construction ambient light levels within Hylebos Waterway under a variety of weather conditions and stages of the moon and design the night-time lighting to not exceed the ambient condition. Maintaining the existing ambient light levels will not degrade the current baseline condition.

2.1.5.1.2 Shoreline Creation and Enhancement Effects on Rearing and Prey Production

The project will include activities that will improve some of the ecological functions for juvenile chinook, and thereby minimize the effects of the proposed wharf.

The project will provide enhanced substrate on the rip rap slope. The shoreline under the proposed wharf will be stabilized by a steel, sheet pile wall and rip rap. The rip rap will be filled with a mixture of crushed gravels between 0.25 and 1.0 inches. This material will improve the characteristics of the rip rap for the production of epibenthic prey for juvenile chinook and will minimize some project effects. The material will be placed between + 12.1 MLLW to + 15.1 MLLW for the entire distance (approximately 540 feet.) of the project site. While the material is not expected to form a continuous layer over the new rip rap, it will fill the interstitial spaces between the rip rap producing a mosaic of habitat that varies from gravel to rip rap. Because of the southern orientation of the site and the provision of natural and artificial light, NOAA Fisheries believes that this material will produce some beneficial effect on the chinook prey base production. As a result of the orientation, the wharf window, pier grating and artificial lighting, it is expected that juvenile chinook will enter underneath the wharf. As the artificial lighting will be set at a level to invite fish passage and possibly allow for visual acuity and feeding (Nightengale pers. comm. 2002) any prey could be a food source for juvenile chinook (Simenstad 2000). Monitoring will be conducted to verify fish utilization

The project includes the conversion of uplands to an intertidal beach on a peninsula located on the eastern side of the Hylebos Waterway toward the waterway mouth, immediately bayward of the East Eleventh Street bridge. This site is owned by the Puyallup Tribe of Indians and is adjacent to Tribal land that has been designated for habitat conservancy and restoration. The peninsula separates a quiescent mudflat from the commercialized Hylebos Waterway. The current elevations of the peninsula range from +11 feet. to +18 feet. MLLW. The habitat creation proposal includes excavation, grading and importing suitably sized gravels on approximately 15,392 square feet of the peninsula, and creating a gently sloping intertidal and upper intertidal profile. To avoid contact and exposure of contaminated subsoils, the underlying soils within the excavation area will be analyzed for contaminants. If required, the soils will be remediated prior to the initiation of excavation. In addition, the site will be cleaned of all concrete debris and then excavated and graded to connect to the intertidal habitat created by adjacent Port of Tacoma enhancement projects (see Port of Tacoma Maersk Sealand Biological Opinion, WSB-00-481). The newly excavated elevations will extend from +11.8 feet to 0.0 feet MLLW. This habitat creation action will improve nearshore intertidal ecological functions and also increase the capacity for juvenile salmon. Upper intertidal habitats are currently limited within the action area (Graeber 1999; Simenstad 2000). This action, coupled with the Port of Tacoma's beach creation on this peninsula will be an important step in improving the overall ecological health of the action area, as well as minimizing the effects of the proposed wharf.

NOAA Fisheries believes that this beach will successfully provide habitat capacity (i.e., prey production and rearing capacity) and improve ecological functions for salmonids in the action area relative to the extent of habitat affected by the proposed construction activities. Other beaches constructed similar to this have been shown to provide comparative benefits to salmon as a natural beach. Examples in the immediate vicinity include the Milwaukee Waterway mitigation and the Slip 1 mitigation beach in the Blair Waterway. Both of these sites are providing ecological attributes critical to the juvenile chinook salmon marine life history stage. These attributes include shallow water refugia, enhanced prey production, conversions of elemental carbon into aquatic plants through photosynthesis, enhanced detrital inputs, and more diverse micro- and macro-biotic assemblages.

The project will enhance the project site beach. The intertidal area of the project site, as well as the area between the site and the intertidal habitat creation area on the tribal peninsula is littered with industrial debris (i.e., concrete, asphalt, and metal chunks, chunks of non-native fill and old metal/polyvinylchloride pipes), and contains deteriorating creosote treated pilings. An asphalt/concrete ramp, previously used for log loading and unloading, also exists on the site. This debris has lowered the value of the native mudflat's production of the benthic prey base. In addition, the proposed wharf will be placed directly over an existing patch of pickleweed, an important upper intertidal plant which provides detritus, prey production habitat, and juvenile salmonid refuge capacity.

The proposed action will remove all existing debris and fill material both on site, between the site and the intertidal habitat creation area on the tribal peninsula, as well as on the intertidal habitat creation area itself. Some old pilings will be removed by breaking them off below the mud line. A portion of the asphalt/concrete ramp is presently covered by sediments, hence, only that portion of the ramp not covered by eight inches of sediment will be removed. All debris will be disposed of in an upland landfill. In addition, LWD will be placed on the site and on the intertidal habitat creation area, however, specific plans for LWD placement have yet to be developed. These actions, when taken together, will provide benefit to both the project site and the action area by enhancing previously degraded intertidal mudflats. This enhancement will provide additional habitat capacity and improve ecological functions for salmonids, as well as minimize effects of the proposed wharf.

Presently, the site contains a patch of pickleweed which was last measured at approximately 745 square feet. This patch will be relocated to the restored upper intertidal area of the asphalt/concrete ramp, and will be placed within an area of approximately 1,500 square feet. As the plants expand to fill the doubled area, the functions served by salt marsh habitat (i.e., detritus production and off-site transport, primary and secondary prey production, and juvenile salmonid refuge) will be doubled.

2.1.5.1.3 Take During Monitoring

Beach seine and fish trap monitoring at the project site will cause direct take of chinook salmon individuals. Beach seine and fish trap sampling could injure or kill chinook juveniles outright. The sampling effects could be reduced by adhering to the following NOAA guidelines: ensuring that a qualified technician is on-site to quickly process each sample (seine or trap); minimizing the time that fish are entangled in the sampling device; placing each fish in a container of water immediately after removal from the sampling device; measuring the fork-lengths while fish are immersed in water; releasing all fish immediately after processing; and observing the behavior of fish after release to confirm live release.

2.1.5.1.4 Stormwater Effects on Rearing Salmonids and Benthic Prey

The proposed wharf will add 15,935 square feet of impervious surface to the existing facility. The stormwater runoff from the facility is presently managed to minimize effects from stormwater pollutants such as bark chips, leachate, and dust, wood and wood leachate, motor oil, diesel fuel and hydraulic fluids. Best management practices (BMPs) for stormwater treatment include oil/water separation, appropriate disposal of waste oil, reuse of hydraulic fluid, wetting of wood chips for dust control, settlement and removal of solids prior to entry into the stormwater system, and covering of most chip and hog fuel conveyors where possible. Following treatment, the current stormwater runoff discharges to the Hylebos Waterway.

No water quality controls for the proposed wharf have been provided in the BE. If stormwater controls are not implemented for the operation of the proposed wharf, long-term direct effects to chinook salmon would be expected to occur. The around-the-clock operation of loading and hauling equipment has the potential to generate oils and greases, and the transport of logs and chips can generate fine woody debris which will fall to the wharf surface, and subsequently to the water. Also, the operation of the wood chip conveyor system has the potential to leak chips to the wharf and the intertidal sediments. Oils and grease, and wood products can contribute polycyclic aromatic hydrocarbons to the water column and bedded sediments. In addition, if the wood chips and debris accumulate on the intertidal sediments, they could smoother the benthic invertebrate prey community and cause anoxic conditions as the wood degrades. It is also reasonable to expect that metals such as zinc and copper from tire and brake wear will enter the water via stormwater runoff from the proposed wharf unless stormwater water quality treatment controls are put into place.

Stormwater based water quality limitations have been identified as examples of potential causes of injury to listed fish in both the draft and final regulations developed to implement the ESA (NMFS 1998b, NMFS 1998c). The definition of "harm" includes discharging pollutants, such as oil, toxic chemicals, radioactivity, carcinogens, mutagens, teratogens, or organic nutrient-laden water including sewage water into a listed species habitat and can possibly cause take. Water quality limitations are associated with triggering the onset of sublethal effects such as disease in previously infected salmonid populations. The onset of disease is thought to be exacerbated by the added stress of poor water quality conditions (NMFS 1998c). In addition, factors associated with urbanization, including pollutants, have been implicated in 58% of the declines and 9% of the extinctions among 417 surveyed stocks (NMFS 1998b).

Presently, the facility has an Industrial Stormwater Permit under the National Pollutant Discharge Elimination System which requires that a current Stormwater Pollution Prevention Plan be in place at all times. This permit will expire on November 18, 2005. If the existing permit extends to the proposed wharf, stormwater BMPs will minimize runoff of untreated stormwater and associated adverse effects to Puget Sound chinook. If the existing permit does not extend to the proposed wharf, re-issuance of the permit should be required. Wood chip accumulation will be minimized as a result of a conservation measure to monitor the chip conveyor system. The applicant proposes to develop and implement a five-year conveyor system and wood waste management efficiency monitoring plan. Adaptive management of the conveyor system and wood waste management program would minimize adverse effects to the benthic prey base and listed fish.

2.1.5.2 Indirect Effects

Indirect effects are caused by the proposed action, are later in time, and are reasonably certain to occur (50 C.F.R. 402.02). Indirect effects may occur outside of the area directly affected by the action. Indirect effects may include the effects of other Federal actions that have not undergone section 7 consultation, but will result from the action under consultation. These actions must be reasonably certain to occur, or be a logical extension of the proposed action. Indirect effects from the proposed action include: 1. altered rearing habitat; and 2. increased shipping effects.

2.1.5.2.1 Altered Rearing Habitats

The proposed wharf might increase predation, causing some loss of juvenile chinook. A number of minimization measures have been proposed. While the under-water lighting proposal is experimental, its evaluation will provide valuable information on the ability to limit disruption of the out-migration of juvenile chinook. If the migration trajectory and schooling characteristics are not disrupted and the juveniles do not move out into deeper water in order to circumnavigate the proposed wharf, the potential for predation will be minimized. In addition, the proposed habitat enhancement and creation measures should help to reduce potential losses. Juvenile chinook will be provided habitat to rear and increase in size both on the site, as well as at the intertidal beach creation site. Continued habitat improvement projects within the Puyallup River, Hylebos Creek and Commencement Bay nearshore habitat will also prepare more fish to make the transition from nearshore to pelagic lifestage, limiting predation losses.

Availability of rearing habitat is important to out-migrating smolts. During their residence in the estuary, juvenile salmonids require refugia for resting, smoltification, and predator avoidance. Mortality during early marine life is often quite high with mortality rates up to 77% occurring during the first several days of life in saltwater (Salo *et al* 1980). The ability of juvenile chinook to survive in the estuary is closely linked with their ability to feed and rear in a safe habitat until they grow sufficiently in size to the point where refugia habitat is no longer necessary. Despite considerable speculation about the effects of over-water structures increasing predation on juvenile salmon, evidence supporting this contention is scientifically uncertain (Simenstad *et al* 1999).

Quantitative assessment of predation around over-water structures is lacking. In their analysis of the literature, Simenstad *et al* (1999) found that the significance of predation to a migrating population of juvenile chinook has never been empirically assessed. Ratte and Salo (1985) attempted to verify enhanced predation associated with over-water structures, and found that predation was shown to be relatively insignificant, and limited to one or two species of predators. Unfortunately, Ratte and Salo's (1985) results are based on very low numbers of fishes caught, including predators, thus rendering the results inconclusive. An interesting finding in this study was that out of 17 individual predators caught in the control site (outside the influence of the pier shadow), nine of these were salmonids. Out of the 19 individual predators caught at the treatment site (under the pier), only two were salmonids. Further, Simenstad *et al* (1999) found that no studies have examined the mortality specifically due to predation, much less that attributable to predators specifically associated with over-water structures.

2.1.5.2.2 Increased Shipping Effects on Migration, Rearing and Benthic and Fish Prey

Two tug boats will assist both the chip and log transport barges during berthing at the proposed wharf (Gerttula 2002). Depending on weather conditions (wind and wave direction) and shipping congestion in the waterway, the barges can take up to ninety minutes to berth once they enter Commencement Bay. The tug boats are run by engines with between 500-4,000 horse power. They have twin propulsion units, which have either conventional (propeller), or cycloidal (turbine-like) drives. Typically, a tug's propulsion unit may be directed in an arc, which originates from the pier line towards the center of the channel (Gerttula 2002). Consequently the thrust developed by these drives may suspend the sediment at the outer edge of the wharf.

The adverse effects from propeller wash from shipping activities within the Hylebos Waterway can not be avoided. However, attempts to minimize on-site and off-site effects from tugs and barges berthing at the proposed wharf can be made. The project includes the development of an operation manual for barge and tug operators who call at the proposed wharf. The manual would provide requirements and operational methods to direct the propellers and the resultant wash away from the project site, towards the center of the waterway. This effort should minimize the extent of sediment disturbance and the duration that the sediment turbidity plume that resides nearshore. With most of the turbidity plume located in deep waters, the adverse water quality and rearing effects to juvenile chinook migrating along the nearshore would be less than currently exists with traditional tug operations. In addition, the disturbance of the benthic invertebrate community will be minimized through the placement of LWD, and the transplanting and expanding the pickleweed patch on-site. These measures will offer areas of protection from disturbance from propeller wash and prevent the symptom of continual disturbance (loss of equilibrium community) to occur completely throughout the project site.
When sediment is mechanically disturbed and suspended, the light penetration is reduced and the chemical characteristics of the water changes. The plume of turbidity composed of silts, sands, and clays may disappear within an hour or two due to dispersion or deposition, or the plume may be transported away from the site by tidal currents. Dependent upon the composition of the material in the plume, the turbidity may remain high as it is transported away from the site.

Sediment disturbance and the associated turbidity is likely to change the chemistry of the water. Estuarine sediments are typically anaerobic and create an oxygen demand when they are exposed to the water's aerobic conditions and oxidized. The chemical constituents of the surface sediments are also in equilibrium with the over-lying water. When deeper sediments are mixed with water the balance is lost and there is a greater potential to mobilize chemical constituents (nutrients, contaminants, and minerals). The resulting water quality in the vicinity of the disturbance is very site-specific and depends upon the physical mixing of the sediment with the water, the sediment's chemical and physical composition, flushing at the site, the tidal cycle, whether the water body is eutrophic, and the amount of organic matter in the sediment.

The water quality effects may affect fish in a number of ways. Simenstad (1988), Waters (1995), and Newcombe and MacDonald (1991) have established that certain levels of turbidity and length of exposure results in adverse effects to fish. They document direct mortality, avoidance, reduced feeding and growth, respiratory impairment, reduced tolerance to disease and toxicants, and physiological stress from suspended sediments. The typical behavioral response to turbid areas is avoidance. Coho salmon, rainbow trout, and Arctic grayling had avoidance responses at suspended sediment levels of 88 to 100 milligrams/liter over short durations (Newcombe and MacDonald 1991).

Another effect of disturbing sediments is the potential loss of benthic and fish prey resources from continual disturbance of the estuary bottom in the waterway and beneath the proposed pier. This physical disruption can often eliminate the established benthic community through displacement or burial. Typically, the benthic community re-colonizes the site quickly, often reaching similar densities within 9-18 months (Kendall pers. comm. 1998). However, a benthic community in a waterway that is constantly disturbed by propeller wash may never develop an "equilibrium community" that is characteristic of undisturbed habitats. Equilibrium communities often have more diverse species composition, a well oxidated layer from bioturbation and larger, but less abundant organisms.

2.1.6 Cumulative Effects

Cumulative effects are defined as "those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation" (50 C.F.R. 402.02). Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

Growth projections predict that Washington's public ports will grow an average of four to five percent over the next 20 years (WDNR 2000). It is projected that shipping container traffic in Puget Sound alone will more than double by 2020. The Seattle and Tacoma ports combined are second only to Los Angeles/Long Beach, California in container traffic for all U.S. ports. In 1963 one in nine jobs in Washington state was trade-dependent. Today, one in four jobs is tied to trade, and by 2005 the ratio is projected to be one in three jobs. Such growth in shipping can have significant impacts on listed fish and their supporting habitat, unless operational practices (i.e., berthing practices, use of anti-foulant paints, spread of exotic species from bilges) are modified.

Significant improvements in Puget Sound chinook rearing and migration in the lower Puyallup River delta and estuary, and Commencement Bay are unlikely without changes in land- and water-use practices, particularly stormwater management, source control and contaminated sediments cleanup, spill prevention and containment, port management practices, and shoreline development. Gradual improvements in habitat conditions are necessary in Commencement Bay, and have been experienced as a result of numerous construction based offset actions, and remediation projects. NOAA Fisheries is aware of efforts that have lead to the development of a Master Development Plan, which describes the framework for redevelopment within and near the action area. The framework includes elements for commercial and/or light industrial development, park and pedestrian access development, boat ramp renovation, as well as revegetation of steep slopes to create forested hillsides similar to those to the north and south of the project site.

One cause of potential cumulative effects is from the use of pesticides used by the Metropolitan Park District of Tacoma on the park vegetation. Standard pesticide registration focuses on concentrations that are lethal for fish when determining application rates and restrictions.

NOAA Fisheries is concerned about sublethal effects such as neurobiological behavior effects stemming from standard rates of application of pesticides (Solomon and Giddings 2000). Environmental relevant concentrations of diazinon has been shown to disrupt homing and anti-predation behaviors in chinook salmon (Scholz *et al* 2000). Similarly, short-term exposures of low concentrations of copper have been found to elicit the same behavioral responses as diazinon (Scholz pers. com. 2002). It is not known to what extent exposure to these and other pesticides have on survival after transitioning from fresh to marine life stage. If there were to be an adverse reaction from sublethal doses, altered shoreline habitats typical of Commencement Bay may compound the effect.

Until improvement in non-Federal actions occur, NOAA Fisheries assumes that future private and State actions will continue at similar intensities as in recent years. However, now that the Puget Sound chinook ESUs are listed under the ESA, and the 4(d) rule is in effect, NOAA Fisheries assumes that private, state and local government project proponents will take steps to curtail or avoid actions that would result in the take of chinook.

2.1.7 Conclusion

NOAA Fisheries determines whether the action is likely to jeopardize the listed species by determining if the species can be expected to survive with an adequate potential for jeopardy. NOAA Fisheries' process for making jeopardy determinations must consider the estimated level of injury or death attributable to: (1) collective effects of the proposed or continuing action, (2) the environmental baseline, and (3) any indirect or cumulative effects. This evaluation must take into account measures for survival and recovery specific to the listed species' life stages. If NOAA Fisheries concludes that the action will jeopardize the species it must identify any reasonable and prudent alternatives available.

NOAA Fisheries reviewed the status of Puget Sound chinook, the environmental baseline for the action area, and the direct, indirect, and cumulative effects of the proposed action. By itself, the proposed wharf will reduce the ecological function of the habitat indicators that are presently not functioning properly. Except for the flats at the mouth of the Puyallup River and isolated native remnant or constructed habitats, nearshore intertidal habitat at the head of Commencement Bay is limited and generally degraded. However, by incorporating minimizing conservation measures, the proposed action's adverse effects will be offset to the extent that the project will not result in the degradation of the baseline habitat within the action area. The information obtained from the monitoring activities may prove that long-term effect of the minimizing measures may actually incrementally improve the ecological function of the baseline.

NOAA Fisheries has determined that the effects of the proposed action would not likely jeopardize the continued existence of Puget Sound chinook salmon. The determination of no jeopardy is based upon the current status of the species and their biological requirements, the environmental baseline for the action area, and the effects of the proposed action. In arriving at a non-jeopardy conclusion for this action, the minimization measures were important to consider against the incremental degradation, attributable to the proposed over-water structure, relative to the not properly functioning baseline condition of the Puyallup River and Commencement Bay nearshore environment.

2.1.8 Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of listed species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species. The following is a discretionary action that the COE can implement in furtherance of its responsibilities under section 7(a)(1) of the ESA.

1. The Edman Holdings company should plant native marsh vegetation on the intertidal habitat created on the tribal peninsula, in coordination with the Puyallup Tribe of Indians, to provide beach stability, detritus, refuge and enhanced prey base to support ecological functions contributing to the rearing of Puget Sound chinook salmon and to the overall ecological health within the action area. This vegetation should be installed during late fall and in advance or concurrent with the proposed wharf project. The marsh vegetation should be monitored throughout the life of the wharf and the plants should be maintained (without use of pesticides or herbicides) or replaced as necessary.

2.1.9 Reinitiation of Consultation

Consultation must be reinitiated if: the amount or extent of taking specified in the Incidental Take Statement is exceeded, or is expected to be exceeded; new information reveals effects of the action that may affect listed species in a way not previously considered; the action is modified in a way that causes an effect on listed species that was not previously considered; or, a new species is listed or critical habitat is designated that may be affected by the action (50 C.F.R. § 402.16).

In addition, reinitiation is required if any of the minimization projects and goals described in the Compensatory Mitigation Plan and Monitoring Program (April 12, 2002) and the Fish Utilization Sampling Program (April 12, 2002) are not met, and/or if performance standards of the various monitoring events (i.e., "wharf window" and artificial lighting, pickleweed transplant, and chip conveyor efficacy) have not been met. Reinitiation will also be necessary if the minimization projects are not constructed in advance or concurrently with construction of the proposed wharf. Lastly, reinitiation will be necessary if the monitoring information is not provided by the required date. If the COE fails to provide specified monitoring information NOAA Fisheries will consider that a modification of the action that causes an effect on listed species not previously considered and causes the Incidental Take State of the Opinion to expire.

2.2 Incidental Take Statement

Sections 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit any taking (harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or attempt to engage in any such conduct) of listed species without a specific permit or exemption. Harm is further defined by NOAA Fisheries to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, spawning, rearing, migrating, feeding, and sheltering (50 C.F.R. 222. 102). Harass is defined as actions that create the likelihood of injuring listed species to such an extent as to significantly alter normal behavior patterns that include, but are not limited to, breeding, feeding and sheltering. Incidental take is take of listed animal species that results from, but is not the purpose of, the Federal agency or the applicant carrying out an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to, and not intended as part of, the agency action is not considered prohibited taking provided that such taking is in compliance with the terms and conditions of this incidental take statement.

The measures described below are non-discretionary; in order for the exemption in section 7(o)(2) to apply, they must be implemented by the action agency so that they become binding conditions of any grant or permit issued to the applicant as appropriate. The COE has a continuing duty to regulate the activity covered in this incidental take statement. If the COE fails to retain the oversight to ensure compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse.

An incidental take statement specifies the impact of any incidental taking of endangered or threatened species. The take statement also provides reasonable and prudent measures that are necessary to minimize impacts and sets forth terms and conditions with which the action agency must comply in order to implement the reasonable and prudent measures.

2.2.1 Amount or Extent of Take

The NOAA Fisheries anticipates that incidental take of Puget Sound chinook is reasonably certain to occur through habitat-related effects. The actual number of individual fish taken as a result of the underlying project is impossible to determine. While direct injury or death may unintentionally result during construction activities, harm is more likely to accrue by exposure of fish to degraded environmental conditions during rearing and migration portions of their life histories. The timing, duration, and extent of such exposure will vary during the course of the project operations, with varying results, described above, all of which fall under the definition of harm. The qualitative results of such effects can be described in this opinion, but no techniques presently exist to correlate those effects with the potential numerical extent of take. Therefore, for the purposes of this opinion, the extent of take is correlated to the extent of habitat affected. Accordingly, the reasonable and prudent measures were developed to address the extent of habitat effects, as described below.

The incidental take statement is based on the premise that all minimization measures described below will be fully implemented. The incidental take of this species is expected to be in the form of harm, harassment, kill and injury, resulting from activities covered under this biological opinion. Incidental take may occur through: 1) shading from the overwater structure affecting the limitation of productivity of epibenthic invertebrates, the movement of early juveniles offshore, and potential migration delays due to the altered light regimes caused by on- wharf lighting; 2) the occurrence of take as a result of monitoring; 3) exposure to heightened levels of organic contaminants from untreated stormwater runoff and loss of wood chips from the conveyor to the aquatic environment; 4) altered rearing habitat; and 5) increased shipping effects.

2.2.2 Reasonable and Prudent Measures

NOAA Fisheries finds that the following reasonable and prudent measures (RPMs) are necessary and appropriate to minimize impacts of incidental take of Puget Sound chinook. The RPMs are partially integrated into the proposed project, however, because of the limited design specifications and completed plans, NOAA Fisheries has included further detail as to their implementation.

1. The COE will minimize take during construction by avoiding or minimizing adverse effects to threatened juvenile Puget Sound chinook refuge and foraging habitat, and migration behaviors.

2. The COE will minimize take during operation of the proposed wharf by avoiding or minimizing adverse effects to threatened juvenile Puget Sound chinook refuge and foraging habitat, and migration behaviors.

3. The COE will minimize take during monitoring activities by avoiding or minimizing adverse effects to threatened juvenile Puget Sound chinook refuge and foraging habitat, and migration behaviors.

2.2.3 Terms and Conditions

1. To implement reasonable and prudent measure No. 1:

    a. The COE shall ensure that construction under the propose permit begins after August 15 and ceases on February 15 of any year.

    b. The COE shall ensure that a final design for the installation of LWD both on-site and at the pensinsula habitat creation site is developed and implemented. NOAA Fisheries shall review and approve the LWD design.

    c. The COE shall ensure that a final design for the intertidal excavation (between 0.0 feet. and 6.0 feet. MLLW) at the pensinsula habitat creation site is developed and implemented. NOAA Fisheries shall review and approve the intertidal excavation design.

    d. The COE shall ensure that photo-documentation and “record-drawings” are submitted to NOAA Fisheries on or before November 15, 2003.

2. To implement Reasonable and Prudent Measure No. 2:

a. The COE shall ensure that all conservation measures identified in the BE dated April 12, 2002 are implemented.

b. The COE shall ensure that the artificial lighting shall effectively pass juvenile salmonids.
(1) The COE shall ensure that the full range of ambient day-light levels are surveyed. NOAA Fisheries shall review and approve the survey plan.

(2) The COE shall ensure that an artificial lighting plan is developed and implemented that identifies all measures to reproduce full spectrum ambient light conditions, and operates and maintains under-wharf lights from one-half hour before dawn to dusk each day during the months of March through July. NOAA Fisheries shall review and approve the artificial light plan.

(3) The COE shall ensure that the efficacy of under-wharf artificial lighting and the "wharf window" is monitored for three years. NOAA Fisheries shall review and approve the monitoring plan.

(4) The COE shall ensure that annual artificial lighting monitoring reports are submitted to NOAA Fisheries on January 1 of each year.

c. The COE shall ensure that an operational manual for barge and tug operator use to direct propeller wash towards the center of the Hylebos waterway is developed and implemented.

d. The COE shall ensure that the full range of pre-construction night-time ambient light levels are surveyed. The final lighting design for the wharf and adjacent upland shall utilize directional lighting that shall not exceed the pre-construction ambient light levels at the water surface. NOAA Fisheries shall review and approve the artificial night-time lighting plan design.

e. The COE shall ensure that the applicant provides documentation that proves that the existing NPDES stormwater permit (Washington Department of Ecology Permit Number: SO3-003019) applies to the proposed wharf, or that the applicant has applied for a re-issuance of the NPDES permit prior to permit expiration.

f. The COE shall ensure that all habitat creation and enhancement is conducted in advance, or at a minimum, concurrent with the start of wharf construction.

3. To implement reasonable and prudent measure No. 3:

a. The COE shall ensure that the success of the pickleweed transplant effort is monitored for at least 7 years. A performance standard of 90% cover shall be achieved. When the performance standard is achieved and maintained for 2 years (in order to establish a healthy root mass) then monitoring can cease.

b. The COE shall ensure that a five year monitoring plan is developed and implemented to evaluate the efficacy of the chip conveyor system and wood waste management practices. NOAA Fisheries shall review and approve the monitoring plan.

c. The COE shall ensure that annual chip conveyor system and wood waste management reports are submitted to NOAA Fisheries on January 1 of each year.

d. The COE shall ensure that annual monitoring reports (to include artificial lighting report, T&C 2, B, iv, and chip conveyor and wood waste management report, T&C 3, C) are submitted to Rachel Friedman of NOAA Fisheries on January 1 of each year.

e. The COE shall ensure that sampling (beach seines and fish traps) is conducted in the following manner: ensure that a qualified technician is on-site to quickly process each sample (seine or trap); minimizing the time that fish are entangled in the sampling device; placing each fish in a container of water immediately after removal from the sampling device; measuring the fork-lengths while fish are immersed in water; releasing all fish immediately after processing; and observing the behavior of fish after release to confirm live release. ESA-listed fish may not be transferred to anyone except NOAA Fisheries personnel, unless otherwise approved in writing by NOAA Fisheries. NOAA Fisheries must be alerted 3 days prior to sampling activities and NOAA Fisheries or its designated representative must be allowed to accompany the sampling team during the sampling activities and must be allowed to inspect the team's records and facilities.

NOTICE. If a sick, injured or dead specimen of a threatened or endangered species is found, the finder must notify the Vancouver Field Office of NOAA Fisheries Law Enforcement at 360/418-4246. The finder must take care in handling of sick or injured specimens to ensure effective treatment, and in handling dead specimens to preserve biological material in the best possible condition for later analysis of cause of death. The finder also has the responsibility to carry out instructions provided by Law Enforcement to ensure that evidence intrinsic to the specimen is not disturbed unnecessarily.

3.0 MAGNUSON-STEVEN FISHERY CONSERVATION AND MANAGEMENT ACT

3.1 Background

The MSA, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), established procedures designed to identify, conserve, and enhance EFH for those species regulated under a Federal fisheries management plan. Pursuant to the MSA:

- Federal agencies must consult with NMFS on all actions, or proposed actions, authorized, funded, or undertaken by the agency, that may adversely affect EFH (§305(b)(2));
- NMFS must provide conservation recommendations for any Federal or State action that would adversely affect EFH (§305(b)(4)(A));
- Federal agencies must provide a detailed response in writing to NMFS within 30 days after receiving EFH conservation recommendations. The response must include a description of measures proposed by the agency for avoiding, mitigating, or offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with NMFS EFH conservation recommendations, the Federal agency must explain its reasons for not following the recommendations (§305(b)(4)(B)).

EFH means those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (MSA §3). For the purpose of interpreting this definition of EFH: Waters include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; substrate includes sediment, hard bottom, structures underlying the waters, and associated biological communities; necessary means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle (50 C.F.R 600.10). Adverse effect means any impact which reduces quality and/or quantity of EFH, and may include direct (*e.g.*, contamination or physical disruption), indirect (*e.g.*, loss of prey or reduction in species fecundity), site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 C.F.R 600.810).

EFH consultation with NMFS is required regarding any Federal agency action that may adversely affect EFH, including actions that occur outside EFH, such as certain upstream and upslope activities.

The objectives of this EFH consultation are to determine whether the proposed action would adversely affect designated EFH and to recommend conservation measures to avoid, minimize, or otherwise offset potential adverse effects to EFH.

3.2 Identification of EFH

Pursuant to the MSA the Pacific Fisheries Management Council (PFMC) has designated EFH for federally-managed fisheries within the waters of Washington, Oregon, and California. Designated EFH for groundfish and coastal pelagic species encompasses all waters from the mean high water line, and upriver extent of saltwater intrusion in river mouths, along the coasts of Washington, Oregon and California, seaward to the boundary of the U.S. exclusive economic zone (370.4 km)(PFMC 1998a, 1998b). Freshwater EFH for Pacific salmon includes all those streams, lakes, ponds, wetlands, and other water bodies currently, or historically accessible to salmon in Washington, Oregon, Idaho, and California, except areas upstream of certain impassable man-made barriers (as identified by the PFMC 1999), and longstanding, naturally-impassable barriers (i.e., natural waterfalls in existence for several hundred years)(PFMC 1999). In estuarine and marine areas, designated salmon EFH extends from the nearshore and tidal submerged environments within state territorial waters out to the full extent of the exclusive economic zone (370.4 km) offshore of Washington, Oregon, and California north of Point Conception to the Canadian border (PFMC 1999).

Detailed descriptions and identifications of EFH are contained in the fishery management plans for groundfish (PFMC 1998a), coastal pelagic species (PFMC 1998b), and Pacific salmon (PFMC 1999). Casillas et al. (1998) provides additional detail on the groundfish EFH habitat complexes. Assessment of the potential adverse effects to these species' EFH from the proposed action is based, in part, on these descriptions and on information provided by the COE.

3.3 Proposed Action

The proposed action is described above in Section B of the ESA Biological Opinion. The action area includes that portion of the Hylebos Waterway influenced by marine waters and Commencement Bay. This area is designated as EFH for various life stages of 17 species of groundfish, four coastal pelagic species, and three species of Pacific salmon (Table 2).

Table 2. Species of fishes with designated EFH in the estuarine composite of Puget Sound.

Groundfish Species	sablefish *Anoplopoma fimbria*	**Coastal Pelagic Species**
spiny dogfish *Squalus acanthias*	bocaccio *S. paucispinis*	anchovy *Engraulis mordax*
California skate *R. inornata*	brown rockfish *S. auriculatus*	Pacific sardine *Sardinops sagax*
ratfish *Hydrolagus colliei*	copper rockfish *S. caurinus*	Pacific mackerel *Scomber japonicus*
lingcod *Ophiodon elongatus*	quillback rockfish *S. maliger*	market squid *Loligo opalescens*
cabezon *Scorpaenichthys marmoratus*	English Sole *Parophrys vetulus*	**Pacific Salmon Species**
kelp greenling *Hexagrammos decagrammus*	Pacific sanddab *Citharichthys sordidus*	chinook salmon *Oncorhychus tshawytscha*

Pacific cod *Gadus macrocephalus*	rex sole *Glyptocephalus zachirus*	coho salmon *O. kisutch*
Pacific whiting (hake) *Merluccius productus*	starry flounder *Platichthys stellatus*	Puget Sound pink salmon *O. gorbuscha*

3.4 Effects of Proposed Action

As described in detail in Section 2.1.5 of this Biological Opinion, the proposed action may result in long-term adverse effects to a variety of habitat parameters. These adverse effects are:

1. As described in Section 2.1.5.1.1, shoreline shading and lighting due to the construction and operation of the proposed wharf will cause direct long-term effects on primary production and subsequently secondary epibenthic invertebrate prey production. In addition, shading will affect juvenile salmonid out-migration. Artificial lighting from industrial operations could delay migration due to disorientation, disperse schools of fish, and/or change their migratory route.

2. As described in Section 2.1.5.1.4, stormwater discharges from the proposed wharf and associated conveyor could cause long-term effects on the water and bedded sediment quality from spill and runoff of bark chips, dust, wood leachate, motor oil, diesel fuel, and hydraulic fluids. Poor water quality is associated with triggering the onset of sublethal effects such as disease, cancerous lesions, and homing and predator avoidance.

3. As described in Section 2.1.5.2.2, increased shipping effects from operation of the proposed wharf could cause continuous turbidity effects from thrusters on the tug boats. Sediment disturbance and the associated turbidity is likely to change the chemistry of the water. In addition, continual disturbance of the sediments in the project area will affect the ability of the benthic prey base to reach equilibrium.

Additional potential short term adverse effects to EFH, not addressed in the Biological Opinion, include:

4. Pile Driving Effects. The response of salmonids to sounds in their environment is varied and not yet fully understood. The typical fright response of salmonids to sound is the “startle” or “start” behavior (Moore and Newman 1956; Burner and Moore 1962; VanDerwalker 1967; Carlson 1997). Avoidance is another behavior response to sound (Knudsen *et al* 1997). Such behaviors involve sudden bursts of swimming that are short in duration and in distance traveled, usually less than 60 centimeters (cm) (Feist 1991). Avoidance behavior has been seen as fish staying away (within 1 meter(m)) from the front of a sound source (Knudsen *et al* 1997). Experiments that have used pulsed, rather than continuous sound stimuli on juvenile fish demonstrated more pronounced “startle” or general avoidance responses (McKinley and Patrick 1986). Pile driving most closely resembles pulsed sound stimuli. Based on the known range of salmonid hearing, pile driving noise would be expected to be heard by salmonids within a radius of at least 600

m from the noise source (Feist 1991; Feist *et al* 1992), although salmon at this range may not exhibit any visible response.

Throughout the study of pile driving effects on juvenile salmonids, Feist (1991) found pile driving operations affected the distribution and behavior of fish schools around the site. For example, the abundance of fish during non-pile driving days was two fold greater than on days when pile driving occurred. Impact pile driving can generate sound pressure levels (SPL) in excess of 192 decibels (dB) (re: 1µPa) (Carlson 1997), which is above the 180 dB shown to damage hair cells of the inner ear of *Astronotus ocellatus* (family: cichlidae) (Hastings *et al* 1996). Long-term exposure (approximately four hours) to these sounds was required to induce the observed damage, whereas the sounds produced by impact pile driving are of short duration. While the minimum SPL required to inflict damage to the hair cells of fishes by such sounds have not been determined, Feist *et al* (1992) theorized it is conceivable that salmonids in close proximity (less than 10 m) to pile driving may experience temporary or permanent hearing loss.

Growing evidence of the effects of pile driving have been demonstrated in the Pacific Northwest. On several occasions, fish mortality and/or fish distress has been observed during installation of steel piles using impact hammers. At the Mukilteo ferry dock, during impact hammer installation of 24 inch and 30 inch pilings, juvenile striped surfperch floated to the surface (WA State Ferries 2001). Recently, the Department of Ocean and Fisheries Canada related that fish mortality of juvenile salmon, perch and herring occurred during impact pile driving of 36 inch steel piling at the Canada Place Cruise Ship Terminal in Vancouver, British Columbia. In both cases, at Mukilteo and the Vancouver Terminal, fish did not appear to be injured when a vibratory hammer was used. At the Port of Vancouver, fish did not appear to be injured when the piling consisted of cement or wood (Salome 2002).

The design of the proposed wharf has not been finalized, hence, it is not clear whether steel piling will be used. Steel sheet piling will be installed above the OHWM line to stabilize the slope. Adverse effects to EFH from driving steel piling with an impact hammer could be significant. Depending upon the size of steel piling, the associated effects could range from schooling dispersal to fish death.

3.5 Conclusion

NMFS concludes that the proposed action would adversely affect the EFH for the groundfish, coastal pelagic, and Pacific salmon species listed in Table 2.

3.6 EFH Conservation Recommendations

Pursuant to Section 305(b)(4)(A) of the MSA, NMFS is required to provide EFH conservation recommendations to Federal agencies regarding actions that would adversely affect EFH. While NMFS understands that the conservation measures described in the BE will be implemented by the COE, it does not believe that these measures are sufficient to address the adverse impacts to EFH described above. Consequently, NMFS recommends that the COE implement the following conservation measures to minimize the potential adverse effects to EFH for the species in Table 2:

1. To minimize EFH impact No. 1, adopt ESA terms and conditions 2.B. and 2.D. in Section 2.2.3 of this document.

2. To minimize EFH impact No. 2, adopt ESA terms and conditions 2.E. in Section 2.2.3 of this document.

3. To minimize EFH impact No. 3, adopt ESA terms and conditions 2.C. in Section 2.2.3 of this document.

4. To minimize EFH impact No. 4, use a vibratory hammer for installation of all steel piling. This will reduce the noise that is generated, and the associated deleterious effects, such as school dispersal and fish death.

3.7 Statutory Response Requirement

Pursuant to the MSA (§305(b)(4)(B)) and 50 C.F.R 600.920(j), Federal agencies are required to provide a detailed written response to NMFS' EFH conservation recommendations within 30 days of receipt of these recommendations. The response must include a description of measures proposed to avoid, mitigate, or offset the adverse impacts of the activity on EFH. In the case of a response that is inconsistent with the EFH conservation recommendations, the response must explain the reasons for not following the recommendations, including the scientific justification for any disagreements over the anticipated effects of the proposed action and the measures needed to avoid, minimize, mitigate, or offset such effects.

3.8 Supplemental Consultation

The COE must reinitiate EFH consultation with NMFS if the proposed action is substantially revised in a manner that may adversely affect EFH, or if new information becomes available that affects the basis for NMFS' EFH conservation recommendations (50 C.F.R 600.920(k)).

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